

Control Tuning as Alternative to Transmission Reinforcement

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What Was The Problem?

A Vestas Site was curtailed and facing significant proposed transmission upgrades

Stability modelling showed severe adverse response including re-triggering of voltage ride through mode

- This caused ~20% voltage swings at the Project POI
- Grid SCR at the POI was <1.75

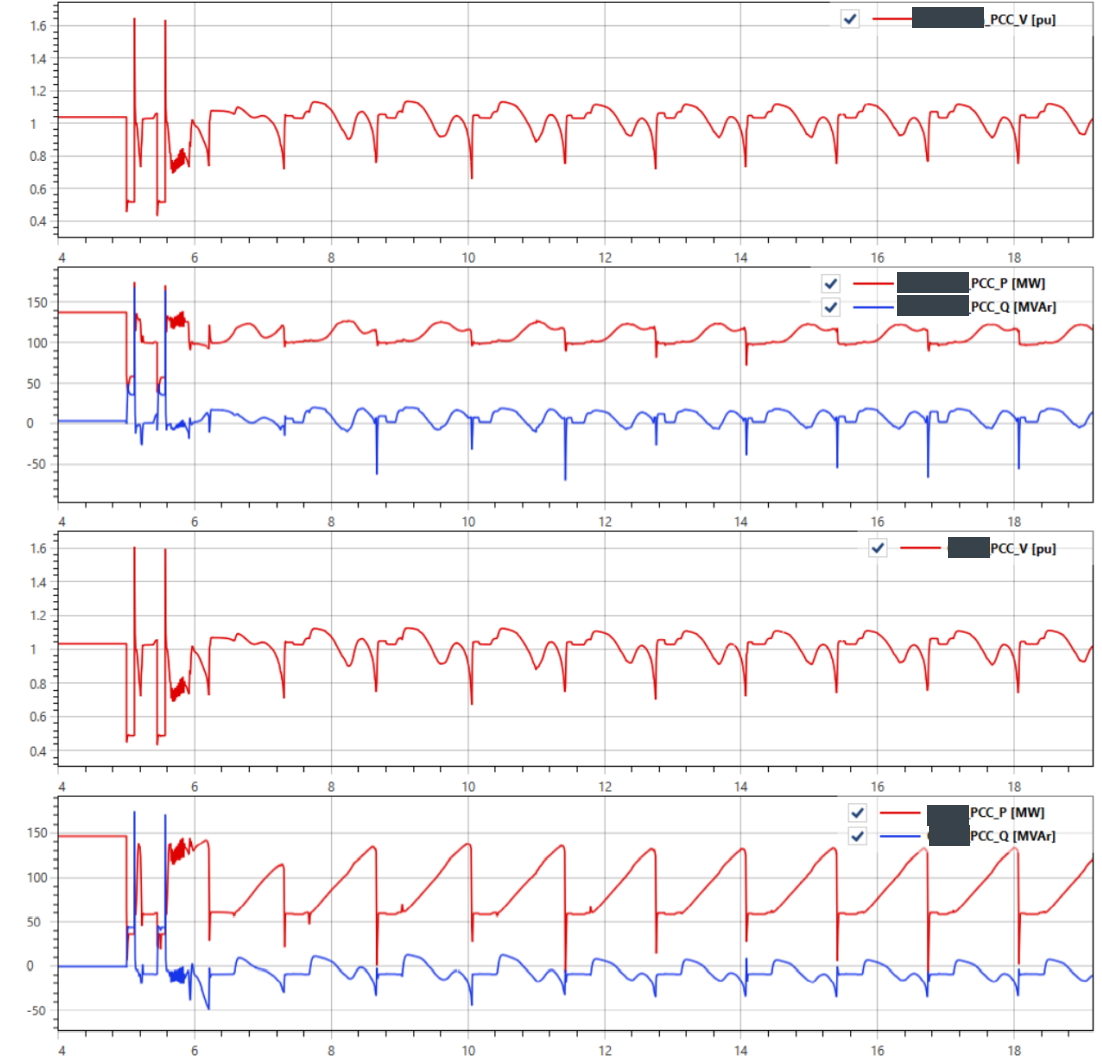
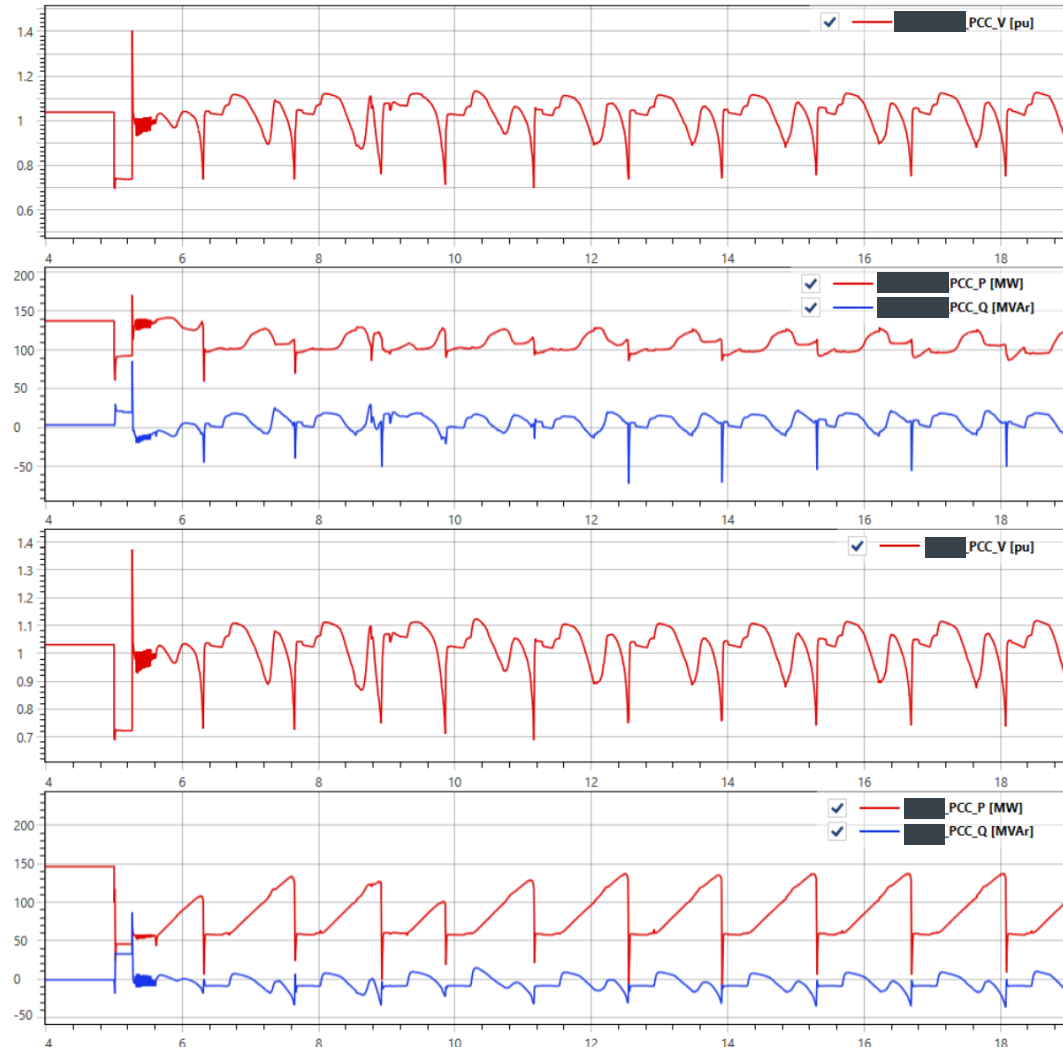
The proposed solutions were costly and came with significant lead times

- Substation re-configuration
- New 138 kV Transmission line
- Grid Side - SVC/STATCOM/Synchronous Condenser
- Project curtailment for many prior outages



Vestas Plant Results for two Severe Planning Contingencies

Both show significant retriggering and typical weak grid response



Study Groundwork and Setup

Vestas needed to work internally, with the Customer, Regional Entities, and their consultants

Work with Customer

- Several meetings with Customer to explain the situation and how site controller tuning could be an alternative solution to the transmissions upgrades

Work with Regional Entities

- Detailed collaboration to discuss the previous study process and to understand the problem grid conditions and contingencies
- Provide technical justification to re-perform two worst planning contingencies in the EMT domain with confirmation in RMS by the consultant
- Work through necessary NDA and process for proper data handling

Vestas Internal Work

- Access and download the Projects' Power Plant Controller and WTG settings
 - Create as-left models to use as tuning starting point
- Recreate a small region of the Grid in PSCAD
 - All other non-Vestas Generators were netted out
 - The fault response was benchmarked against the RMS study



Vestas Internal EMT Study

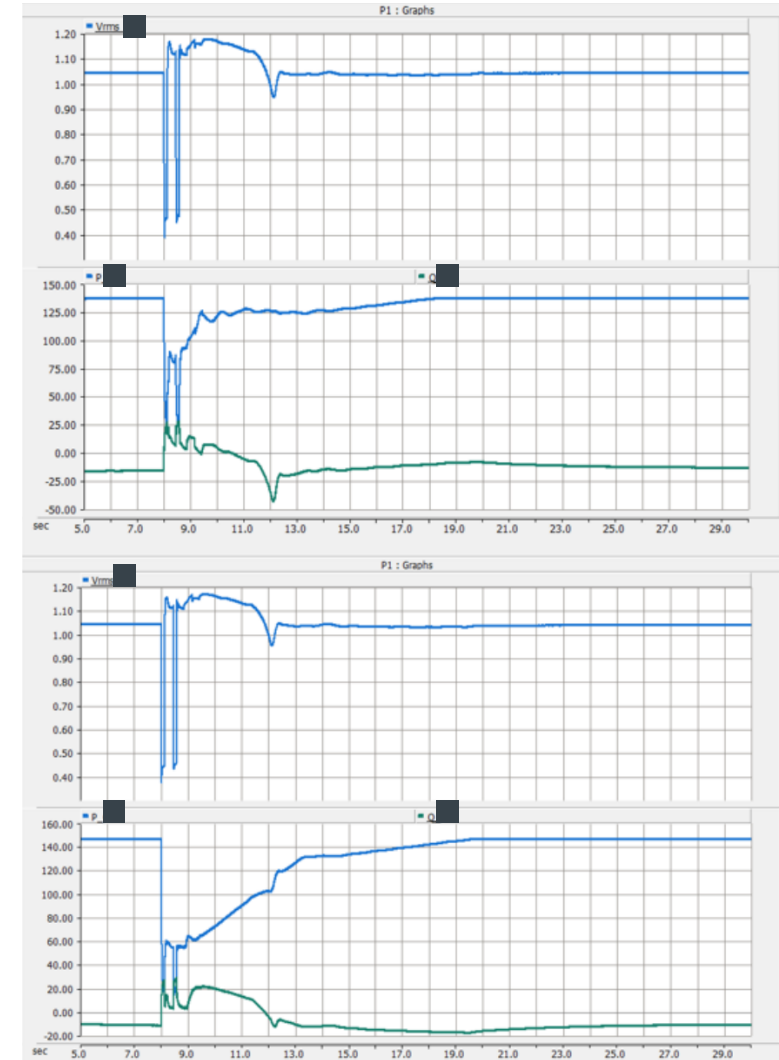
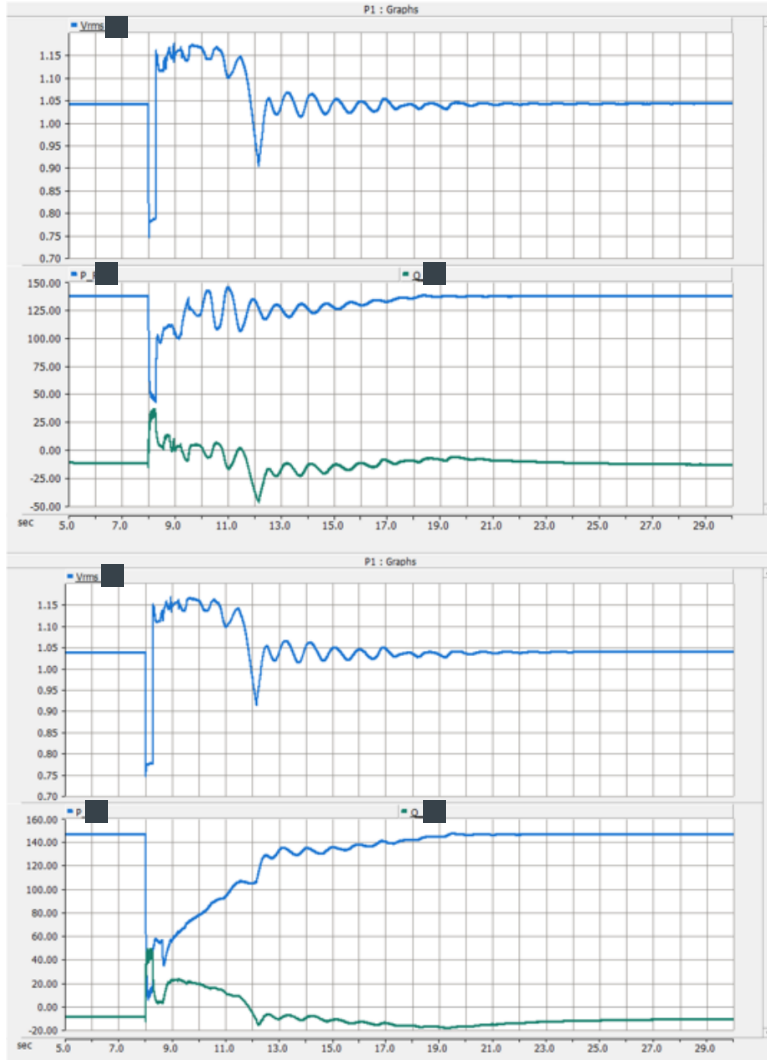
The two worst planning events were studied in the EMT domain and the Vestas controllers were tuned

- Changes were made to both the Plants' Power Plant Controllers and WTG control parameters
- The new parameters showed stability in the EMT domain for the two worst contingencies
- Parameters from the EMT model were transferred exactly to the RMS models and these models were studied and approved for all planning contingencies under Regional Entity procedure
- In parallel, the parameters were studied internally to ensure they would not damage the WTG or reduce the WTG lifespan
- After internal and external approval of the parameters they were installed on-site with exact mapping to the studied parameters



Vestas Plant Results for Two Severe Planning Contingencies

Both show stable post-fault response within Regional Entity Criteria



Conclusions

- Changes were made to the Vestas PPC and WTG in order to achieve stable response under all planning events
 - PPC active and reactive power recovery time was slowed down
 - Post-fault active recovery was lowered
 - WTG fault ride through gains were lowered
 - WTG fault ride through thresholds were expanded
 - Further changes to internal, load related parameters
- These changes, along with significant and detailed coordination with the Customer and Regional Entity resulted in a non-transmission based solution to the stability problem
- Exercises like this are encouraged throughout the industry such that non-transmission solutions may replace erroneous transmission construction
 - This will help optimize the North American BES/BPS
 - May reduce costs to rate payers as fewer erroneous transmission elements will be constructed
 - Will begin to utilize features present but currently unused in many BES connected IBR as they cannot be represented with Standard Library Modelling
- Widespread User-written modelling will be essential

